

REMARKS

Examiner Nadav is thanked for his thorough examination of the Subject Patent Application. Amendments have been made to the Claims, and in so doing are now believed to render the Claims distinguishable from Examiners cited prior art and therefore be in condition for allowance. In addition as Examiner kindly suggested, the abstract has been amended to more accurately describe a structural or device invention, not a process or method invention. The drawings have been amended, regarding figures 6, and 7B, to now be consistent with the other drawings, specifically the top view of Fig. 7A.

Referring to the rejection of Claims 20 - 24, based on 35 USC 112, regarding lack of support for the term "space", Figs. 6, and 7B, have been amended to show metal spacers 8c, now located on the sides of via hole opening 6b, however not covering the entire top surface of recessed plug structure 7b. This was clearly intended and clearly shown as a top view in Fig. 7A, wherein a space can be seen exposing a portion of recessed metal plug 7b, surrounded by metal spacers 8c. Now amended Figs. 6 and 7B, also show the same space shown in top view Fig. 7A. In addition the specification states in the issued method patent of this invention (US 6,245,657 B1), col 4, lines 10 - 11, "Metal sidewalls 8c, form a metal ring, or metal shunt structure, overlying a portion of underlying, tungsten plug structure 7b". The description of a portion clearly shows the metal spacers were not intended to be continuous as erroneously shown in Figs. 6 and 7B, but with a space as correctly shown in the top view of Fig. 7A, and now in amended cross-sectional views of Figs 6 and 7B. In addition, as Examiner stated, the confusing

and unclear. "upper level metal interconnect structure connected to a lower level metal interconnect structure, and an attached metal ring structure, comprising: a lower level metal interconnect structure" has been corrected in amended Claim 20. Therefore reconsideration of the rejection of Claims 20 - 24, based on 35 USC 112, is requested as a result of the amendments made to the Claims as well as to corrections made to Figs. 6 and 7B.

Referring to the rejection of Claims 20 and 24, under 35 USC 102, as being anticipated by Harada et al (US 5,341,026), independent Claim 20, has been amended to more clearly describe applicants structure and in so doing become clearly distinguishable from the Harada et al prior art. Independent Claim 20, now clearly describes a metal structure comprised of a planar metal component attached to only one side of an adjacent metal ring component, with the metal ring structure terminating at the top surface of the via hole opening, on the side opposite the planar metal structure. Harada et al, certainly do not show this structural feature only showing metal structure 100, in a via opening and extending from the via hole to overlay planar surfaces of insulator layer 5, in all directions, or on all sides of the via hole opening, therefore attached to all sides of adjacent planar metal structure. Again applicant's metal ring structure intentionally terminates at the top surface of via hole opening 6b. In addition the metal ring component described by applicant is comprised of metal spacers or sidewalls located on the sides of via hole opening 6b, as well as overlying only a portion of recessed plug structure 7b. This is observed in top view Fig 7A, as well as in amended Figs 6 and 7B, and well as described in the specification of US Pat. No. 6,245,657 B1, col 4, lines 10 - 11. Therefore resulting in a space

which exposes the portion of recessed metal plug 6b, not covered by metal spacers 8c. The Harada et al prior art does not show the discontinuous metal spacers described by applicant, only describing a continuous metal structure 100, in a via hole opening. Therefore reconsideration of independent Claim 20, and referencing dependent Claims 21 - 24, rejected based on 35 USC 102, is requested based on the amendments made as well as based on the arguments presented.

Regarding the rejection of Claims 20 - 24, under 35 USC 103, the amendments made to the Claims, and the arguments presented in response to the 35 USC 102 rejection, are again used. No prior art (Harada et al, US 5,341,026), describe the unique features of applicants structure, such as the space between metal spacers exposing only a portion of the top surface of the recessed metal plug structure, as well as the metal ring structure terminating at the top of a via hole opening, only on one side, while attached to a planar metal structure component on another side of the via hole opening. The rejected dependent Claims 21 - 24, now refer to amended independent Claim 20. Therefore since none of Examiner's cited prior art describe the unique structural features listed in applicants amended structural invention, neither will any combination of prior art offer applicants structure. Applicant has claimed his process in detail. The structure shown in Fig. 7A and amended Fig. 7B, and described in amended Claims 20- 24, are both believed to be novel and patentable over Examiner's cited art references, because there is no evidence that these prior arts described a planar metal structure attached to a metal ring structure, (attached on only one side), wherein the metal ring structure in turn is comprised with metal spacers, featuring a space between the sidewall metal spacers that allow exposure of a portion of

TSMC99-646BC

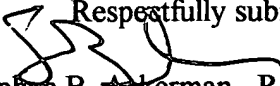
the top surface of an underlying recessed metal plug. We therefore request Examiner Nadav to reconsider his rejection of Claims 20 - 24, under 35 USC 103, in view of these arguments and the amendments to the Claims.

Allowance of all Claims is requested.

Attached hereto is a marked-up version of the changes made to the Claims by the current amendment, as well as the changes made to the drawings and to the abstract. The attached page is captioned.

"Version with markings to show changes made"

It is requested that should Examiner Nadav not find that the Claims are now Allowable that he call the undersigned attorney at 845-452-5863, to overcome any problems preventing allowance.

Respectfully submitted,

Stephen B. Ackerman, Reg # 37,761

VERSION WITH MARKINGS TO SHOW CHANGES MADE

PLEASE AMEND THE ABSTRACT AS FOLLOWS:

ABSTRACT

[A process for fabricating an upper level, metal interconnect structure, self-aligned to an underlying metal plug structure, which in turn overlays, and contacts a lower level, metal interconnect structure, has been developed. The process features the formation of a recessed metal plug structure, in a via hole, overlying and contacting a portion of the top surface of the lower level, metal interconnect structure. Deposition of a metal layer is followed by a patterning procedure which results in the formation of a metal structure component, located on the surface of an insulator layer, defined by an overlying photoresist shape, with the metal structure component attached to a metal ring component, which is located in a top portion of a via hole, overlying and contacting, portions of the top surface of the recessed metal plug structure, with the metal ring component formed during the same patterning procedure, however unprotected by the photoresist shape. The metal ring structure is comprised of metal spacers, located on the sides of the top portion of the via hole.]

A metal interconnect structure featuring a metal ring component located entirely in a via hole opening, and attached to an adjacent planar metal structure component, has been developed. The planar metal structure component is located on a smooth top surface of an underlying insulator layer, while the metal ring component is located entirely in a top portion of a via hole

opening which in turn was defined in the insulator layer, with the via hole opening exposing the top surface of a recessed metal plug structure. The metal ring component, attached to only one side of the planar metal structure component, is comprised of metal spacers located on the sides of the via hole opening, with the metal spacers also overlying portions of the recessed metal plug structure located at the bottom of the via hole opening. The space between metal spacers allows exposure of an uncovered portion of the recessed metal plug structure.

PLEASE AMEND THE DRAWINGS AS FOLLOWS:

Please amend Figs. 6 and 7B, wherein metal sidewalls or spacers 8c, now overlay only a portion of the top surface of recessed metal plug structure 7b, resulting in a space between metal spacers. The space between metal spacers 8c, exposes a portion of the top surface of recessed metal plug structure 7b. This is now consistent with Fig. 7A, in which the space between metal spacers is clearly shown, exposing a portion of the top surface of recessed metal plug structure 7b.

PLEASE AMEND THE CLAIMS AS FOLLOWS:

20. (AMENDED) [An upper level] A metal [interconnect] structure on a semiconductor substrate, [comprised of a metal structure located on a smooth top surface of an underlying insulator layer, and an attached metal ring structure in turn comprised of metal spacers,] comprising:
- 5 a via hole in an insulator layer exposing a portion of an underlying lower level metal interconnect structure
- [a lower level metal interconnect structure;]
- [said insulator layer located on said lower level metal interconnect structure;]
- [a via hole in said insulator layer exposing a portion of a top surface of said lower
- 10 level metal interconnect structure;]
- a recessed metal plug structure located in a bottom portion of said via hole, with said recessed metal plug structure overlying and contacting the portion of said lower level metal interconnect structure, exposed in said via hole; and

said metal structure comprised with a first portion located on a smooth top surface of said insulator layer situated only adjacent to one side of said via hole, and with said metal structure comprised with a second portion attached to said first portion of said metal structure, wherein said second portion is a metal ring structure comprised of metal spacers located on the sides of a top portion of said via hole and located overlying only first portions of a top surface of said recessed metal plug structure located at the bottom of said via hole, resulting in a space between said metal spacers exposing a second portion of said top surface of said recessed metal plug structure.

[said upper level metal interconnect structure, comprised of said metal structure and comprised of attached said metal ring structure, wherein said metal structure is located only on one side of via hole on a portion of a top surface of said insulator layer, and also located on an edge of underlying, said recessed metal plug structure, and wherein said metal ring structure, attached to said metal structure, is located overlying, and contacting only portions of a top surface of said recessed metal plug structure, with said metal ring structure comprised of metal spacers on the sides of a top portion of said via hole with a space located between said metal spacers exposing a portion of a top surface of said recessed metal plug structure.]

21. (AMENDED) The [upper level] metal [interconnect] structure of claim 20, wherein said lower level metal interconnect structure is comprised of a composite metal structure, featuring an aluminum, or an aluminum based layer, at a thickness between about 2000 to 20000 Angstroms, with an underlying titanium nitride layer, at a thickness between about 100 to 1500 Angstroms, and an overlying titanium nitride layer, at a thickness between about 100 to 1500 Angstroms.
- 22.(AMENDED) The [upper level] metal [interconnect] structure of claim 20, wherein said via hole is comprised with a diameter between about 0.10 to 1.0 um.
23. (AMENDED) The [upper level] metal [interconnect] structure of claim 20, wherein said recessed metal plug structure, is comprised of tungsten, with the height of said recessed metal plug structure, located in said bottom portion of said via hole, between about 3000 to 20000 Angstroms.
24. (AMENDED) The [upper level] metal [interconnect] structure of claim 20, wherein said metal ring structure, attached to said first portion of said metal [interconnect] structure [of said upper level metal interconnect structure], is comprised of aluminum, or aluminum - copper spacers, located on the sides of said top portion of said via hole.